A DEVICE AND PROCESS FOR OPERATING ON A MOVING LAMINAR MATERIAL, IN PARTICULAR FOR A BAG-MAKING MACHINE

Field of the Invention

The invention relates to a device and a process for operating on a moving

5   laminar material, in particular for a bag-making machine.

The bag-making machine is of the type having at least one work unit adapted to heat-seal, cut or mold laminar material such as a ribbon or film of plastic material, and having actuating members adapted to make the laminar material move forward at the work unit.

10   ## Description of the Prior Art

It is known that in machines operating on a material moving through several different work stations, it is important that the operating modalities should be set in such a manner that they do not require the temporary stopping of the material and the intermittent movement of same. This for the purpose of increasing the

15   production rate to an important degree by eliminating down times for interruptions as well as the problems connected with slowing and restarting that are inevitably entailed by an intermittent movement.

In particular in bag-making machines the required production rate is to be as high as possible to reduce costs.

20   A high production rate then allows all bags of a given type to be made with a single machine. In fact bags differentiate from each other as regards their structure, shape, sizes, thickness, transparency, color, holes, surface finish, printed elements, accessory elements, etc. and in the presence of all these variations it is advantageous that the various operations for production setting-

25   up should be made on a single machine.

A continuous operation in the bag-making machines is also suitable because these machines carry out heat-sealing operations on the laminar material which are subjected to accidental tears in the presence of the strong accelerations imposed by an intermittent movement.

5   Even when tears are avoided, tensioning due to accelerations imposed by an intermittent movement easily causes permanent sets on the laminar material and the bags at the heat-sealed regions where the high temperature applied lasts for some instants.

In spite of the stated importance of a continuous working, a characteristic of the

10   bag-making machines is exactly that of operating with an intermittent advancing of the material being processed.

In fact different working operations, in particular heat-sealing, require a relatively prolonged contact time with the plastic material.

Therefore a technical solution is generally adopted in which the laminar material

15   is caused to move forward in an intermittent manner and in which the work units intervene during the interruption moments.

However, bag-making machines have already been studied in which the members operating on the laminar material being processed are movable along a trajectory adjacent to the material itself.

20   The work members may be translated along appropriate guides at least partly parallel to the material being processed, so as to maintain a relatively prolonged contact therewith, then the movement direction of the work members is reversed for return to the starting position, for a new operation.

This technical solution gives rise to high mechanical stresses at the moving

25   members so that oscillations and work inaccuracies can be created, which is

very unpleasant because every occasional malfunction leads to rejection of a great number of articles and/or interruptions for machine resetting.

Therefore a very precise and expensive construction is required also involving use of special materials to reduce weights and occurrence of forces of inertia and

5 vibrations.

Summary of the Invention

Under this situation the technical task underlying the invention is to conceive a device and a process capable of obviating said drawbacks of the prior art, and capable of carrying out an efficient continuous working which is reliable and of

10 reduced costs even in the presence of members operating on the material being processed that have important sizes and masses.

The technical task mentioned is achieved by a device for operating on moving laminar material, in particular for a bag-making machine, said machine being of the type having at least one work unit and actuating members adapted to make

15 the laminar material move forward at a reference speed, the device comprising: at least one rotating body having a rotation axis and a rotation speed, at least one guide member in engagement with said rotating body at an eccentric position with respect to said rotation axis and movable along a circumferential trajectory having a work stretch; said guide member being connected with said

20 work unit and having, in said circumferential trajectory, a tangential speed with a work component parallel to the laminar material, and drive means designed to selectively vary said rotation speed and reference speed in a manner adapted to make said work component in said work stretch and said reference speed substantially equal to each other.

25 ## Brief Description of the Drawings

The features and advantages of the invention will be more apparent from the following detailed description of preferred embodiments of the invention, with reference to the accompanying drawings, in which:

– **Fig. 1** is a diagrammatic perspective view of the device in accordance

5   with the invention made active on two opposite work units;

– **Fig. 2** is a diagrammatic perspective view of the device in accordance with the invention made active on a single work unit;

– **Fig. 3** shows the device at support means for work units equipped with a carriage and column-shaped posts movable in a direction both perpendicular and

10 parallel to the laminar material;

– **Fig. 4** is similar to the preceding figure and uses column-shaped posts only movable in a direction parallel to the laminar material;

– **Fig. 5** highlights the device simultaneously active on many work units disposed in side by side relationship;

15 – **Fig. 6a** shows the device active on two opposite work units in mutual approaching and supported by spring compensation members;

– **Figs. 6b, 6c, 6d** are similar to Fig. 6a and show starting, intermediate and final contact positions respectively of the work units, emphasizing the action of the spring compensation members;

20 – **Fig. 7a** shows how the work component T_L of the tangential speed T varies in a body rotating at a constant rotation speed ω;

– **Fig. 7b** further shows through Cartesian coordinates, how the value of the work component T_L varies in the case shown in Fig. 7a;

– **Fig. 8** shows how the tangential speed T varies in a rotating body having

25 a variable rotation speed ω;

– **Fig. 9** shows through Cartesian coordinates, how the rotation speed ω

varies in the case shown in the preceding Fig. 8;

– **Fig. 10** shows an embodiment of the drive means of the device;

– **Fig. 11a** shows a further embodiment of the drive means and emphasizes

5   a shaped pulley in a first operating position;

– **Fig. 11b** is similar to the preceding figure and shows the shaped pulley in

a second operating position;

– **Fig. 12** is a front view of the profile of the shaped pulley;

– **Fig. 13** is a plan view of the shaped pulley; and

10   – **Fig. 14** shows the actuating members of the laminar material and a

further embodiment of the device in accordance with the invention.

Description of the Preferred Embodiments

With reference to the drawings, the device **1** in accordance with the invention is

provided to operate on a moving laminar material and is particularly applied to a

15   machine to make bags of plastic material.

Device **1** is placed close to at least one work unit **2**, defined by a welding bar for

example, and said laminar material denoted at **3** consists for example of a ribbon

of plastic material having several superposed layers that are locally welded

and/or cut and/or folded.

20   The laminar material 3 is moved forward at the work unit 2 with a substantially

flat lying arrangement defining a reference plane.

Moving forward is obtained by actuating members comprising opposite and

powered calenders for example, that in a manner known by itself clamp and drag

along the laminar material. A particular embodiment of said actuating members is

25   shown in Fig. 14.

The movement or sliding speed of the laminar material 3 is herein defined as reference speed and is identified with V_R.

A single work unit 2 may be present or two or more work units 2 may be provided, that are opposite to each other in pairs and simultaneously operate in a

5 synergistic manner with each other to simultaneously intervene on the two opposite faces of the laminar material 3.

Figs. 1, 3, 4, 5, 6a, 6b, 6c, 6d, 14 show opposite work units 2 active on opposite faces of the laminar material, whereas Fig. 2 shows a single work unit.

In addition, device 1 in accordance with the invention is intended both for

10 simultaneously acting on several work units 2 (in Figs. 1, 5, 6a, 6b, 6v, 6d, 14) and for acting on a single work unit 2 (in Figs. 2, 3, 4).

It is further pointed out that the work units 2 extend transversely of the movement direction of the laminar material 3 and that the same can be supported at their ends by identical devices 1, symmetrically placed at the edges of the laminar

15 material 3. In the figures said devices 1 are shown at an edge alone of the laminar material 3, being understood that possible devices on the other edge, to engage both ends of the work units 2, are substantially identical with those shown.

At all events, device 1 provides that at least one work unit 2 be connected,

20 through support means **4**, with a guide member **5** actuated by a rotating body **6**. The rotating body 6 is a crank, a wheel or others and has a rotation axis **6a** that is substantially parallel to the reference plane locally formed by the laminar material. In addition, the rotation axis 6a is transverse to the sliding or reference speed V_R of the material itself.

25 In the instances shown the rotating body 6 is always a wheel with a central

rotation axis 6a perpendicular to the extension plane of the wheel itself.

The rotating body 6 has a rotation speed ω with respect to the rotation axis 6a the value of which will be better specified in the following.

The guide member 5 is in engagement with the rotating body 6 at an eccentric

5   position relative to the rotation axis 6a and is movable along a circumferential trajectory **7**.

In the embodiments shown the guide member 5 is a pin eccentrically emerging from the wheel embodying the rotating body 6, in a direction perpendicular to the extension plane of said wheel. It is however apparent that the guide member 5

10   can be structured in different ways, it may be an articulated and rotatable fulcrum equipped with bearings, or also a mere seat or an attachment element set on the rotating body 6, or on the contrary a structure widely emerging from the rotating body 6.

At all events the guide member 5 is dragged along the circumferential trajectory

15   7 centered on the rotation axis 6a.

Along the whole circumferential trajectory 7, the guide member 5 has a tangential speed **T** that is perpendicular to the radius r joining the guide member 5 to the rotation axis 6a. The value of the tangential speed T depends on the angular speed ω and on radius **r**, based on the known formula **T = ω r**.

20   The tangential speed T can then be resolved into two components perpendicular to each other: a work component T_L parallel to the reference speed V_R of the laminar material and a transverse component, locally perpendicular to the laminar material 3.

The work component T_L is important because it denotes the motion of the guide

25   member 5 in the same direction as that of the laminar material 3.

Figs. 7a, 7b show the value of the work component T_L in the case of a constant rotation speed ω.

In particular, Fig. 7a shows the work component T_L in a portion of the circumferential trajectory 7 defining a work stretch **7a** of same. The work stretch

5   7a is shown as symmetric to a symmetry plane **8** passing through the rotation axis 6a and perpendicular to the laminar material 3, but the work stretch 7a can be freely selected as regards both position and width.

Preferably the work stretch 7a of the circumferential trajectory 7 passes through the symmetry plane 8 and has a length defining a central angle β – at the center

10   of the circumferential trajectory 7 – larger than 20° and smaller than 180°, for example.

It is apparent that the work component T_L forms a work angle α with the tangential speed T, which work angle gradually grows as the distance of the guide member or pin 5 from the symmetry plane 8 increases, and also that the

15   work component gradually decreases with the distance itself from the symmetry plane 8, taking a value that can be clearly defined by the formula $T_L = T \cos \alpha$.

In Fig. 7a the tangential speed T is constant along the whole work stretch 7a and the value of T is selected to be the same as the value of the reference speed V_R of the laminar material.

20   Thus the work component T_L takes a value equal to T and to the reference speed V_R at the symmetry plane 8.

The overall course of the work component T_L in Fig. 7a is then denoted through Cartesian coordinates in Fig. 7b where on the ordinates there is the value of T_L and on the abscissas the value of the work angle α.

25   It is apparent at all events that when ω and T are constant, the guide member or

pin 5 moves along the work stretch 7a with a variable work component T_L.

If the central angle β is small, included between about 20° and 40° for example (and therefore the work stretch 7a extends in a very reduced manner at the sides of the symmetry plane 8) the work component T_L varies to a minimum degree

5   relative to the tangential speed T.

In this case, if the tangential speed T is equal to the reference speed V_R of the laminar material, as already assumed, the contact between the work unit 2 and laminar material 3 does not create important deformations thereon.

A small central angle β and a short work stretch 7a are only possible if the

10   laminar material moves forward slowly, thus in any case giving the work unit 2 the required time for operation, in spite of the reduced contact region.

When a substantial increase in the production rate is wished, the reference speed V_R of the laminar material must be greatly increased and therefore contact between the work unit 2 and laminar material 3 must take place over a larger

15   work stretch 7a, to give the work unit 2 the required time for operation.

Practically the work stretch 7a must define a relatively wide central angle β, included between about 60° and about 120° for example.

However, in this case, at the end portions of the work stretch 7a, the work component T_L takes values that are much different from the tangential speed T

20   and therefore from the reference speed V_R. Practically, the displacements of the guide member 5 become incompatible with those of the laminar material.

Under this situation of increased speed of the laminar material 3 drive means **9** adapted to selectively vary the tangential speed T of the guide member 5 along the work stretch 7a or the reference speed V_R of the laminar material 3 are

25   advantageously arranged to impose a work component T_L and a reference speed

V_R equal to each other or with reduced differences that in any case fall within the tolerance limits.

In other words, the work component T_L and reference speed V_R are adjusted relative to each other point by point over the whole work stretch 7a.

5 In an embodiment of the invention the drive means 9 only intervenes on the rotating body 6 and imparts a continuously varying rotation speed ω to the same, so that the guide member 5 is given a work component T_L, point by point, that is substantially equal to the reference speed V_R of the laminar material 3, over the whole work stretch 7a.

10 More specifically, if the reference speed V_R is constant, the rotation speed ω is caused to vary instant by instant – at least over the work stretch 7a – in inverse proportion to the cosine of said work angle α.

In fact, if in the already mentioned formula $T_L = T \cos \alpha$, we set $T_L = V_R$ (and also taking into account the fact that $T = \omega r$) we obtain $\mathbf{V_R = \omega\ r\ cos\ \alpha}$.

15 If in the last-mentioned formula the rotation speed ω is highlighted, it appears:

$$\omega = \bar{V_R} (r \cos \alpha).$$

Upon variation of the rotation speed ω, the tangential speed T of the guide member 5 varies as well, in accordance with the formula

$$T = \bar{V_R} \cos \alpha$$

20 that is obtained taking into account the fact that if $T = \omega r$, ω can be replaced by T/r.

The tangential speed T too, therefore, can be varied in inverse proportion to the cosine of the work angle α.

Fig. 8 shows the variations of T in the work stretch 7a when $T_L = V_R$.

The work stretch 7a is symmetric to the reference plane 8 and in addition it

25 subtends a central angle β of 120° at the rotation axis 6a. Therefore the

tangential speed T of the guide member or pin 5 varies between a minimum

value at the symmetry plane 8 and a maximum value equal to twice said

minimum value, at the ends of the work stretch 7a.

The values taken by the rotation speed ω in the work stretch 7a are represented

5   through Cartesian coordinates in Fig. 9 wherein ω is on the ordinates and the

work angle α is on the abscissas.

For varying the rotation speed of the rotating body 6 – and the tangential speed

of the guide member or pin 5 – the drive means 9 is made up of at least one

motor **10** and an adjusting apparatus **11** connected with motor 10.

10   In the particular embodiment shown in Fig. 10, motor 10 is preferably a DC

electric motor of the brushless type, capable of quickly and precisely varying its

rotation speed. This electric motor is used for controlling rotation of CD-ROM and

hard disks in computers, where a great accuracy and quick variations in the

rotation speed are required.

15   As also shown in Fig. 10, the adjusting apparatus 11 comprises electronic

devices **12** and sensors **13**.

The electronic devices 12 include circuits known by themselves and called SLM

(Speed Loop Module) circuits used in the so-called "Full Digital" technology.

Sensors 13, embodied by proximity sensors for example, detect the angular

20   position of the rotating body 6 and can be disposed adjacent to any suitable point

of the device, as diagrammatically shown in Fig. 1, or they may be preferably

disposed adjacent to a small shaft or stem **14** coaxial with the rotation axis 6a to

detect the angular position of tailpieces **15** positioned on the stem 14 itself.

Stem 14 is set in rotation by motor 10 through a belt **10a** or equivalent actuating

25   means.

Further sensors **16** can be provided for detecting the reference speed V_R of the laminar material 3. Said further sensors 16 are particularly useful when the device 1 is inserted in a machine initially made without the device itself in order to obtain an appropriate control of the operational features of said machine.

5   As well apparent in Fig. 8 for example, the circumferential trajectory 7 comprises a second stretch or return stretch **7b** different from the work stretch 7a and this return stretch 7b has a predominant length.

If the distances between two consecutive interventions are very reduced, when the device is put on a machine designed to obtain from the laminar material,

10   bags of reduced length and tightly consecutive to each other, the electric motor 10 must increase its rotation speed to restore the work conditions as soon as possible.

In the embodiment shown in Figs. 11a and 11b it is still the rotation speed ω of the rotating body 6 that is continuously varied in the above specified manner to

15   adapt the work component T_L, point by point, in the work stretch 7a, to a substantially constant reference speed V_R, but motor 10 can be a standard electric motor operating at a substantially constant rotation speed and the adjusting apparatus 11 is placed downstream of motor 10 and is interposed between the latter and the rotating body 6.

20   In this case the adjusting apparatus 11 comprises transmission members comprising kinematic non-circular elements adapted to convert a substantially constant rotation speed into a rotation speed at least partly variable in inverse proportion to the cosine of the work angle α.

In particular, at least one shaped pulley **17** is provided which has a non-circular

25   profile with respect to its rotation center **17a**.

The shaped pulley 17 is coaxially in engagement and rigidly connected with the rotating body 6.

As shown in Fig. 12, the shaped pulley 17 is substantially elliptic and has a major symmetry axis **17b** and a minor symmetry axis **17c** that are orthogonal to each

5   other and intersect at the rotation center 17a with the major axis 17b having a length that is substantially twice and even more the length of the minor axis 17c. For instance, the major symmetry axis 17b can have a length slightly longer than twenty centimeters, and the minor symmetry axis 17c a length of about ten centimeters. The arched outer profile of this shaped pulley 17 then gradually

10   extends between first portions P_1 having a radius of curvature of about five centimeters and placed at the ends of the major symmetry axis 17b, and second portions P_2 having a radius of curvature of about thirty centimeters and placed at the ends of the minor symmetry axis 17c.

The same outer profile is engaged by a flexible connecting element preferably

15   consisting of a toothed belt **18**. The shaped pulley 17 is therefore a toothed pulley.

The toothed belt 18 is wrapped on at least one auxiliary pulley **19** of the toothed type too and having a simple circular profile for example and a diameter similar to the length of the minor symmetry axis 17c of the shaped pulley 17.

20   The auxiliary pulley 19 is directly and coaxially connected with stem 14 driven by motor 10 or connected with motor 10 in a different manner.

Where necessary, at least one tightener **18a** can be inserted between the shaped pulley 17 and auxiliary pulley 19, to keep tensioning of the toothed belt 18 always constant.

25   It is pointed out that the transmission ratio between the two pulleys 17 and 19

varies continuously: depending on its position, the shaped pulley 17 appears like a big virtual wheel W_1 of wide virtual diameter (Fig. 11a) or like a small virtual wheel W_2 of reduced virtual diameter (Fig. 11b).

Upon increasing of this virtual diameter the rotation speed of the shaped pulley

5   17 decreases, together with the rotation speed of the rotating body 6 rigidly connected therewith. Vice versa, on decreasing of the diameter the rotation speed increases.

In said case involving an auxiliary pulley 19 with a diameter substantially equal to the minor symmetry axis 17c of the shaped pulley 17, the pulleys can establish

10   with each other both a transmission ratio where the rotation speed of the shaped pulley 17 is lower than half the rotation speed of the auxiliary pulley 19 (Fig. 11a) and a transmission ratio one to one where equal rotation speeds exist (Fig. 11b). Practically, the combination involving the shaped pulley 17 and auxiliary pulley 19 ensures variations in the rotation speed ω of the rotating body 6 between a

15   minimum value, such set as to generate a tangential speed T of the guide member 5 equal to the reference speed V_R of the laminar material, and a maximum value that is substantially twice and even more said minimum value. To obtain still wider variations in the rotation speed of the rotating body 6, starting from an electric motor 10 operating at a substantially constant rotation

20   speed, the auxiliary pulley 19 too can have a non-circular profile relative to its rotation axis. In particular the profile of the auxiliary pulley 19 can be substantially elliptic too.

In more detail, the possible peripheral extension of an auxiliary pulley 19 that is elliptic as well is a submultiple of the peripheral extension of the shaped pulley

25   17, in such a manner that a given variation in the transmission ratio is

periodically repeated at the work stretch 7a.

Even if an electric motor 10 operating at a substantially constant rotation speed and non-circular transmission members are used, it is possible to obtain easily modifiable operating situations.

5   For example, the overall work rate can be modified by suitably selecting the fixed value of the rotation speed of the electric motor and in addition the work component T_L of the tangential speed T can be modified by varying the radius r of the circumferential trajectory 7.

In fact, the guide member 5 can be disposed and fixed to a suitable distance

10 from the rotation axis 6a.

To this aim adjusting means **20** is provided that is adapted to fix the guide member or pin 5 to a radial position at will, on the rotating body 6.

The adjusting means 20 is diagrammatically shown in Fig. 2 as embodied by slits **20a** enabling a guide member 5 consisting of a pin conforming in size to said

15 slits to be positioned and then fixed at will, by means of opposite washers **20b** for example.

It will be recognized that said transmission members with non-circular kinematic elements can be also used in combination with electronic devices 12 and sensors 13 adapted to vary the rotation speed of the electric motor 10.

20 In a further embodiment of the invention, the drive means 9 varies, point by point, the reference speed V_R in such a manner as to adapt the same to the work component T_L of the tangential speed T, selected on the basis of suitable convenience criteria.

In particular the rotating body 6 can be given a constant rotation speed ω and

25 therefore the guide member 5 along the circumferential trajectory 7 can be given

a constant tangential speed T.

In this case, as seen, the work component T_L of the tangential speed T varies in the work stretch 7a in proportion to the cosine of said work angle α. In fact the work component T_L is defined by the formula $T_L = T \cos \alpha$. Practically, the work

5   component T_L is reduced at the ends of the work stretch 7a and is maximum at the symmetry plane 8.

For adapting the reference speed V_R of the laminar material 3 to these variations in the work component T_L, said speed is caused to vary in proportion to the cosine of the work angle α. In fact, if in said formula defining T_L, we set $V_R = T_L$

10   and $T = \omega\, r$, it is obtained:

$$V_R = T \cos \alpha \quad \text{and also} \quad V_R = \omega\, r \cos \alpha$$

In order to vary the speed of the laminar material 3, the drive means 9 does not act on the rotation speed of the rotating members 6 for which specific drive elements **26** are provided, but it acts on actuating members **27** causing

15   movement of the laminar material 3.

In the embodiment illustrated in Fig. 14 it is shown the choice of operating by varying the reference speed V_R of the laminar material 3, in which figure the drive means 9 acts on actuating members 27 comprising calenders **28** disposed opposite in pairs, so as to drag along the laminar material 3 between them at

20   varying speeds even instant by instant.

Shown in Fig. 14 is an electric motor 10 for each pair of calenders 28 but a single motor suitably linked to the calenders and the other devices may be provided. The speed V_R of the laminar material is caused to vary in synchronism with the position and action of the work unit 2 and therefore the drive means 9 is provided

25   with said sensors that, among other things, detect the position of the work bar 2.

Irrespective of the choice of varying the rotation speed ω of the rotating body 6,
point by point, or the sliding speed V_R of the laminar material 3, the rotating body
6 and guide member 5 are not directly connected with the work unit 2: in fact the
above mentioned support means 4 is provided between the guide member 5

5   and work unit 2.

The support means 4 is adapted to change, at the work stretch 7a, the
circumferential trajectory or the trajectory in the form of an arc of a circumference
of the guide member 5 to a trajectory of each work unit 2 that is linear and
parallel to the laminar material 3, without altering the speeds imposed by the

10   guide member 5 in a direction parallel to the laminar material 3. The support
means 4 is further adapted to keep the angular lying of each work unit 2 relative
to the laminar material 3 substantially constant.

In detail, the support means 4 comprises compensation devices 21 that in the
embodiment shown in Figs. 1, 3, 4, 5, 6, 14 are defined by deformable elements

15   in the form of springs, whereas in the embodiment shown in Fig. 2 are defined by
deformable elements in the form of at least one fluid-operated cylinder.

In both cases the compensation devices 21 are guided by gudgeons 22 and
extend between the work units 2 and elements that are movable with the guide
member 5. Said elements are defined in Figs. 1, 3, 4 by longitudinal members

20   23 spanning the laminar material 3, from edge to edge, and/or by crosspieces
24 – one for each edge of the laminar material 3 – as shown in Figs. 2 and 5.

It is pointed out that the work units 2 extend transversely of the movement
direction of the laminar material 3 and that they can be supported at the ends by
identical devices 1, symmetrically disposed at the edges of the laminar material 3.

25   The action of the compensation devices 21 is highlighted in Figs. 3a, 3b, 3c, 3d,

where the same are represented by a spring and where two opposite work units

2 are shown that simultaneously act in a synergistic manner on opposite faces of .

the laminar material 3, upon command of the rotating bodies 6.

It is apparent that when a work unit 2 covers the work stretch 7a of its

5   circumferential trajectory, it comes into contact with the laminar material 3 (Figs.

3b, 3c, 3d). Under this situation the different profiles of the work stretch 7a and

the reference or lying plane of the laminar material 3 are compensated for by

said spring enabling the respective work unit 2 to remain level with the laminar

material.

10   The support means 4 further comprises, as said, a framework adapted to keep

the angular lying arrangement of the work unit 2 with respect to the laminar

material 3 substantially constant.

Practically said framework prevents the respective work bar 2 and the

compensation devices 21 from overturning or changing their angular position

15   with respect to the laminar material 3 both over the work stretch 7a and also over

the whole circumferential trajectory 7 of the guide device or pin 5.

This allows the centrifugal forces, vibrations and tensioning in the device to be

further reduced.

The framework can be made in different ways.

20   In Figs. 1 to 4 it is provided a framework or frame defined by said two crosspieces

24 that are substantially parallel to each other, at least one of which is movable

together with the guide member 5, and by at least two column-shaped posts 25

extending between the crosspieces 24, perpendicular thereto. The column-

shaped posts 25 slidably engage at least one of said crosspieces 24.

25   On the contrary, in Fig. 5 the crosspieces 24 themselves embody said framework

and they have a great extension in length and take the aspect of tie-rods, so as

to cause interlocking, on rotation, of a plurality of rotating bodies 6 disposed

consecutively in a direction parallel to the reference speed V_R.

In more detail, in Fig. 1 said framework is inserted in a device having the rotating

5   body 6 directly in engagement by meshing with a similar rotating body. The

respective guide members 5 are vertically aligned with each other and offset

through 180° and control respective opposite work units 2. To this aim the two

rotating bodies rotate in opposite ways, as also shown in Figs. 6a to 6d.

The framework has two crosspieces 24, one for each guide member 5, and two

10 column-shaped posts 25 fastened to the lower crosspiece 24 and slidable in the

upper crosspiece 24.

In Fig. 2 the framework is inserted in a device in which two rotating bodies 6 are

always provided, but the second rotating body is an auxiliary one and only

designed to support one crosspiece 24 and posts 25, since there is only one

15 work unit 2 in engagement with a single rotating body 6.

In this case the two rotating bodies can either directly mesh with each other or

be spaced apart and connected by a belt or the like so as to rotate in the same

way. Pins 5 can be 180° offset from each other or in the same position.

If two work units 2 active in opposite ways on the laminar material 3 are

20 provided, in the case in Fig. 1 two devices 1 in accordance with the invention are

provided, at the edges of the laminar material 3, whereas in the case in Fig. 2

four devices 1 in accordance with the invention are provided, one for each end of

each work unit 2.

To simplify the structures, a crosspiece 24 can substantially define a carriage **29**

25 constrained to carry out a linear movement.

Possibly, carriage 29 can be associated with a work unit 2 that therefore remains immediately adjacent to the laminar material 3 and that, upon the action of the column-shaped posts 25, linearly moves in synchronism with the other work unit 2, controlled by the guide member 5.

5   This technical solution is shown in Figs. 3 and 4.

In Fig. 3 the guide member 5 moves both an upper crosspiece 24 – connected with an upper work unit 2 – and the column-shaped posts 25, rigidly fixed to the upper crosspiece 24 and axially slidable in the second crosspiece defining a carriage 29. The latter is supported and guided in a direction parallel to the

10   laminar material 3 by one or two guide bars **30**.

In Fig. 4 the guide member 5 still moves the upper crosspiece 24, but the latter is not rigidly fixed to the column-shaped posts 25. In fact the column-shaped posts 25 slidably pass through the upper crosspiece 24 and are rigidly connected to carriage 29 that is movable in a direction parallel to the laminar material 3 due to

15   the presence of a guide bar 30. Possibly, as shown in the figure, an auxiliary carriage **31** may be provided that is also rigidly connected with the column-shaped posts and guided by at least one auxiliary bar **32** parallel to the guide bar 30.

Finally, in Fig. 5 the framework or frame stabilizing the position of the work units 2 is substantially defined, as already mentioned, by the crosspieces 24 alone,

20   which have a great extension in length and take the aspect of tie-rods, so as to cause interlocking, on rotation, of a plurality of rotating bodies 6 disposed consecutive to each other in a direction parallel to the reference speed V_R.

Under this situation – if the guide members 5 of the consecutive rotating bodies 6 have identical circumferential trajectories 7 and are in the same position along

25   the respective circumferential trajectories – crosspieces 24 keep always parallel

to the laminar material 3.

This structure allow various work units to be disposed along the path of the laminar material 3, so as to simultaneously carry out in different regions of the laminar material 3, various successive working operations to gradually form

5   many bags disposed consecutively.

The crosspieces 24 of Fig. 5 also allow transmission of motion between consecutive rotating bodies 6.

The above described device 1 puts into practice a guide process for a work unit 2. In accordance with this process at least one guide member 5 is provided to be

10   moved along a circumferential trajectory 7 and the work unit 2 is provided to be connected thereto. This circumferential trajectory is selected to be adapted to cause the work unit to interfere with the laminar material 3 over at least one work stretch 7a thereof.

The guide member 5 along the circumferential trajectory 7 has a tangential

15   speed T having a work component T_L parallel to the reference speed V_R of the laminar material 3.

In an embodiment of the process the tangential speed T of the guide member 5 is provided to be varied in a manner adapted to keep the work component T_L substantially equal to the reference speed V_R.

20   In the case of a substantially constant reference speed V_R, the tangential speed T of the guide member 5 is varied in the work stretch 7a in inverse proportion to the cosine of the work angle α included between the tangential speed T and the work component T_L thereof.

In a further embodiment of the process the tangential speed T of the guide

25   member 5 is maintained substantially constant along the circumferential

trajectory 7 and on the contrary it is the reference speed V_R of the laminar

material that is varied.

Said reference speed is varied in proportion to the cosine of the work angle α,

when the work unit 2 comes into contact with the laminar material 3 and the

5   guide member 5 covers the work stretch 7a.

Practically, the laminar material is caused to move forward at an increasing

speed when the guide member 5 covers the first half of the work stretch 7a and

at a decreasing speed when it covers the second half.

If the work stretch 7a is of the type shown in Fig. 5, i.e. it is symmetric with

10   respect to said symmetry plane 8, and in addition it subtends a central angle β of

120°, the laminar material 3 doubles its speed in the first half and goes back to

the starting speed in the second half.

In addition, preferably the work unit 2 is movably engaged with the guide

member 5 in a manner adapted to vary the position of the work unit 2

15   downstream of the guide member 5 itself in the presence of stresses thereon.

The invention achieves important advantages.

In fact the work unit 2 can operate in a very precise manner on a continuously

moving laminar material 3 or ribbon.

In addition it is possible to arrange a wide contact region by varying the work

20   stretch 7a, so that also relatively prolonged operations can be executed on the

moving material, in particular heat-sealing.

Movement of the work unit 2 then can be very quick without this involving

vibrations or too high stresses or work inaccuracies, and without requiring

provision of special materials, since the guide member 5 follows a simple

25   circumferential trajectory, devoid of discontinuity points and without motion

reversals. This results in a high production rate and a substantial reduction in working rejections.

The work unit 2 then always keeps a correct position relative to the laminar material, by virtue of the presence of the support means 4.

5 The device can be applied in a particularly advantageous manner to bag-making machines, requiring high production rates and relatively prolonged interventions on the laminar material of which the bags are made.

Also eliminated in these machines are the accidental tears and local deformations on the bags at the heat-sealing regions, which tears and

10 deformations result from stopping and restarting of the laminar material in the presence of an intermittent movement.

In the case of two work units defined by two opposite welding bars and acting in a synergistic manner on opposite faces of the laminar material, the two bars take a mutually opposite position with a gradual movement and a gradually

15 increasing pressure, strong impacts being avoided.

It will be finally recognized that the device has an independent structure and therefore can be advantageously inserted in previously built machines devoid of the device itself.